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This issue contains the index for Volume 14.

MINOR ARTS

WHEN you think of art you think mainly of painting, sculpture, and architecture. These are the 'big three' branches of art – but the visual arts can take many other forms. We call these the *minor* or *decorative* arts. We will look at some of the most important in this article, but there are many more besides these – stained-glass designing, leather work, and lace-making are just a few of them. Many of the minor arts started as crafts in the Middle Ages, and are still practised because they are useful as well as beautiful. For this reason they are often known as the *applied* arts.

TEXTILE WORK

17th-century Florentine tapestry

Tapestry is a way of weaving ornamental designs. First practised by the Ancient Egyptians, the art flourished in Flanders in the Middle Ages – centred on Arras, Bruges, Tournai, and Brussels; and from the 17th century onwards in France, where the Gobelins factory is the most famous. A modern example is the tapestry in the new Coventry Cathedral.

17th-century carpet from Asia Minor

Carpets (from the Latin *carpere*, to pluck) originated in the East, where it was the custom to eat and pray sitting cross-legged on carpeted floors. Persian and Turkish carpets are still the most prized and valuable.

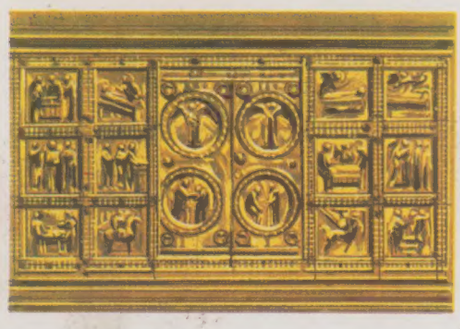
18th-century silk brocade

Brocades are silk and satin textiles decorated with raised patterns of gold or silver thread. In the 14th century Italy was the European centre; since the 17th century France has led the field.

METAL WORK

The most widely used metals in decorative work are **gold, silver, brass,** and **wrought iron.** Gold and silver have for centuries been fashioned into elaborate dishes and ornamental objects, often heavily engraved and set with precious stones, and occasionally used to decorate furniture. Brass provided an inexpensive medium; elaborate candlesticks and dishes were made from it, and it was also used to bind and decorate furniture. Brass is widely used in eastern countries; Indian brasswork was at one time very popular in England, while the beautiful locks and handles on Korean chests are of a much higher standard. Wrought iron is used to make elaborate and beautiful gates, balconies, firescreens, and hinges.

Elaborate silver vase, inset with jewels



Ornate golden altar, in the Church of St Ambrose, Milan

Ormolu, an alloy of copper with other metals (including zinc and tin) which has a rich gold colour, was frequently used in the 18th and 19th centuries for furniture mountings and for elaborate clock cases. The name is also applied to gilded brass or copper.

Previous page: Some examples of the minor arts: a 16th-century cameo of chalcedony; an agate cup with an elaborate enamelled stand, also 16th-century; a delicate 19th-century porcelain figurine; a workcase made of gold and precious stones (17th-century)

MICHELANGELO – his work

DURING his lifetime Michelangelo was called 'The Divine'. Today we are used to extravagant praise being lavished on artists, but in the 16th century this was unknown – unknown, that is, until Michelangelo appeared on the artistic scene.

Throughout the Middle Ages even brilliant artists had been regarded as little more than superb craftsmen. The Renaissance (see page 2349), with its emphasis on visual things, attracted more attention to artists, and some, it is true, like Raphael (see page 1994), became immensely popular. But Michelangelo was revered; he was looked up to as someone possessing mysterious powers denied to ordinary men. He taught great princes and monarchs that artistic genius could not be bought with money. Although he was often harassed by his wealthy patrons, in the end it was *he* who dictated to *them*. Today we are used to such phrases as 'artistic temperament', and recognise artists as peculiarly gifted people; but Michelangelo was the first great artist to be treated as such.

Michelangelo's Moses, *designed for the Julius II monument, and now in S Pietro in Vincoli, Rome*

On page 929 we looked at Michelangelo's life (1475–1564). Now we are going to look more closely at his work as a sculptor, painter, and architect. In all these spheres Michelangelo's achievements are among the most brilliant in the history of western civilisation.

Michelangelo the sculptor

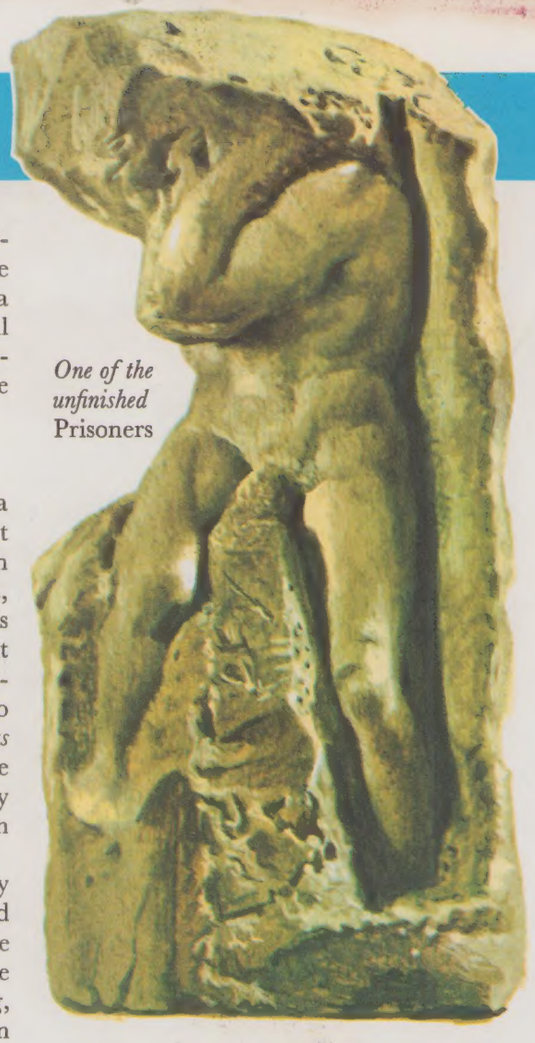
Michelangelo thought of himself as a sculptor above all else. Indeed, the great hunks of marble, the excavation of which he supervised personally at Carrara, were the best possible medium for his monumental figures. He once said that the figures he sculpted were already within the stone and that his job was to release them. If we look at his *Prisoners* (one is shown above, right) we can see what he meant; the figures seem literally to be struggling to free themselves from the stone.

Michelangelo depicted the human body in a manner that had not been attempted since the days of the Ancient Greeks. He admired physical beauty almost to the point of worshipping it; and in his painting, as well as his sculpture, he created an idealised, heroic type of figure that was completely new. He seldom bothered to catch likenesses. His men are not portraits; they are simply strong, forceful, and almost superhuman people.

Moreover, mediaeval artists had never sculpted or painted human figures for their own sakes; they had used them to tell a story and had nearly always concealed all but their faces in flowing garments. In the Renaissance this changed; in the 15th and 16th centuries artists began to pay great attention to the human form, but it took Michelangelo to make the break with tradition complete. Almost all his works, both pictures and sculpture, contain nude figures: he seldom included much else unless it was essential to the subject-matter.

In 1501 he began work on his statue of *David*, which was placed in a position of honour in the central square in Florence. This figure of a heroic young man was Michelangelo's first attempt at creating his physical ideal, and is still used as a model by art students from all over the world.

In 1505 Michelangelo was commissioned to sculpt the monument to the colourful 'soldier Pope' Julius II (see page 686). The monument was originally planned to be of enormous dimensions, but the scale was gradually reduced by Julius's executors. In fact, Michelangelo only managed to complete *Moses* (see left) and two *Slaves* which are now in the Louvre Museum in Paris. Michelangelo regarded this monument as his most important project, and its frustration made him extremely bitter. The Medici popes who succeeded Julius would give Michelangelo no peace during the time he was working on their family tombs in San Lorenzo, the Medici church in Florence. Michelangelo never managed to complete these either, but his statues of Giuliano and Lorenzo de' Medici, two young warriors, and the figures representing *Night* and *Day*, and *Dawn* and *Dusk*, above which they are enthroned, are truly magnificent.



One of the unfinished Prisoners

But Michelangelo's reputation as a sculptor rests most, perhaps, on his *Pieta*. He sculpted this subject, the pity of the Virgin Mother for her dead Son, four times. He produced the *Pieta* in St Peter's when he was still in his early 20s, and he was working on the *Rondanini Pieta* (in Milan) – an intensely religious and moving work which many consider would have been his most impressive – when he died shortly before his 90th birthday.

Sistine Chapel, Rome; the Last Judgment *and the magnificent ceiling. They took Michelangelo ten years to complete*

Detail from the Flood *scene of the Sistine Chapel ceiling*

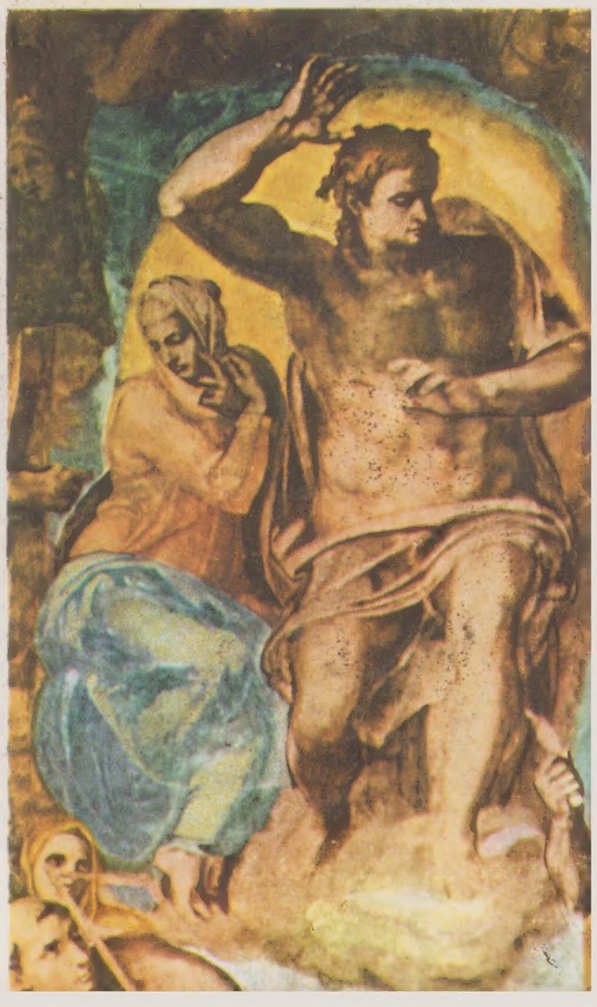
Michelangelo the painter

We find the same forcefulness and energy which characterise Michelangelo's sculptures in his painting. The strong, muscular figures in his *Holy Family*, one of his earliest paintings, make it totally different from the serene representations of the same subject by his contemporaries. Michelangelo's greatest paintings are enormous frescoes, and in some ways the challenge of vast expanses of wall which he could fill with figures gave him opportunities he never had in stone. In 1504 he designed a fresco to decorate the great hall of the Palazzo Vecchio in Florence. It was to balance one on the opposite wall by Leonardo da

Detail from the Last Judgment; *every figure of this vast fresco is a powerful masterpiece*

Vinci (see page 353). Michelangelo chose as his subject the Florentine defeat of the Pisans at Cascina in 1364. Although we only know his design from a copy, for the original was destroyed, we can see that this fresco – a mass of soldiers in a hundred different positions – would have been one of the greatest figure paintings ever.

The Sistine Chapel ceiling, however, commissioned by Pope Clement VII, and begun in 1508, still survives and is as sensational as when it was unveiled. Michelangelo was reluctant to undertake the work, which involved completing the religious cycle which other earlier artists had begun on the walls of the chapel, and which consisted of scenes from the Old



Christ judging the world; the central figure of Michelangelo's Last Judgment

Head of the Creator (detail, Sistine ceiling)

The Delphic sybil (Sistine ceiling)

Testament up to the time of Moses. But once he had started, he painted furiously for four and a half years, lying in acute discomfort on his back. The plan of this greatest of ceilings was immensely lavish, grandiose, and complicated. It covers 600 square yards. There are nine panels with five scenes of the Creation, one of the Fall, and three from the life of Noah. He began with Noah and painted backwards, ending with the Creation. The scenes are surrounded by figures of prophets, sybils, slaves, and ancestors of Christ. Every figure is a powerful masterpiece, proving once more how Michelangelo gloried in portraying the human body. But despite this variety there is an artistic unity about the whole creation. Against it, the wall frescoes by earlier painters – Ghirlandaio, Botticelli, Perugino, and Pinturicchio – appear almost mediaeval. In 1534 Michelangelo was again at work in the Sistine Chapel on a huge fresco of the *Last Judgment* for the altar wall. This fresco, with its overpowering masses of 'the saved' on one side and 'the damned' on the other seething around the majestic, all-powerful Christ (see left), dominates the chapel. It is very different from his ceiling of nearly 30 years earlier. Indeed as he grew old Michelangelo became increasingly religious. This we can see in the tormented figures of the *Last Judgment* which has the intensity of a nightmare.

The prophet Daniel (Sistine ceiling)

MICHELANGELO THE ARCHITECT

Michelangelo's passion for grandeur found a natural outlet in architecture. In 1520 he began the chapel in San Lorenzo which he designed as a setting for the ducal tombs (see page 2689). It was very rare for one man to have the opportunity of designing both sculpture and its setting in this way. Soon after, Michelangelo designed the Medicean library which was attached to the church of San Lorenzo. Between 1535 and 1546 he was engaged on replanning the Capitoline Hill in Rome. His stately group of three palaces, surrounding the ancient mounted figure of Marcus Aurelius, was not finished until after his death.

Pope Paul III commissioned Michelangelo to complete the Farnese Palace in Rome which belonged to the Pope's family, and, on the death of Antonio da San Gallo in 1546, he made him chief architect of St Peter's Church (see page 2049). This was about the greatest honour that could be conferred on any Renaissance architect. Michelangelo completely remodelled Bramante's original plan. He only lived to see the lower portion of his great dome finished, but this, far higher and majestic than Bramante's, is one of Michelangelo's masterpieces and, many people think, the greatest dome of its type in the world. It had a great influence on later architects, in particular on Sir Christopher Wren when he was rebuilding St Paul's Cathedral.

Michelangelo's grandiose dome (St Peter's, Rome) contrasts strikingly with the simplicity of that of Brunelleschi (inset: Santa Maria dei Fiori, Florence), built 100 years earlier

Michelangelo the man

Michelangelo (see right) was described by Vasari, a contemporary of his, as: 'a very healthy man, thin and muscular, although as a boy he was sickly . . . he could support any amount of fatigue. He was of middle height, wide across the shoulders, but the rest of his body in good proportion'. When he was a young man he was struck across the face by a fellow student, Torrigiano, and permanently disfigured – a tragedy in one who admired physical perfection as he did. Throughout his life he was subject to bouts of deep depression; but, although he never married, he was devoted to his family. Michelangelo was a deeply religious man, which can be seen in his poetry, the fourth art in which he excelled.

In most temperate climates the activities of man and the process of nature are much the same. Here is a typical Alpine summer scene

SUMMER

SUMMER in Britain is the time of year for holidays and picnics, for cricket and tennis, and for strawberries and cream. But enjoyable though these pleasures are, the real significance of summer, particularly in the temperate regions of the earth, is quite different and far more important. Summer is the time of year when the sun shines warmly on the crops and provides them with the light and warmth which they need to grow and mature. Without the summer sunshine the crops would fail and their value as foodstuffs would be negligible.

The sun's light and warmth, which are really forms of energy, are needed by plants as they synthesise their tissues. In this process the solar energy is trapped in the plants' complex chemical molecules. When, later, the crops are eaten, the plant tissues are digested and the trapped energy is released. It is used in animals' bodies to produce muscular energy. In this way summer sunshine is the source of energy for all living creatures.

One of the ways in which men systematically 'capture' the sun's energy is the cultivation of corn crops. During the summer plants absorb the sun's light and warmth, using them in the formation of their stems and leaves, and, in particular, of their seeds. These seeds are composed largely of starch, a substance very rich in energy, and when the corn is used for food the starch is converted into sugar. The sugar is transported to the muscles where it 'burns' to provide the energy for muscular contraction.

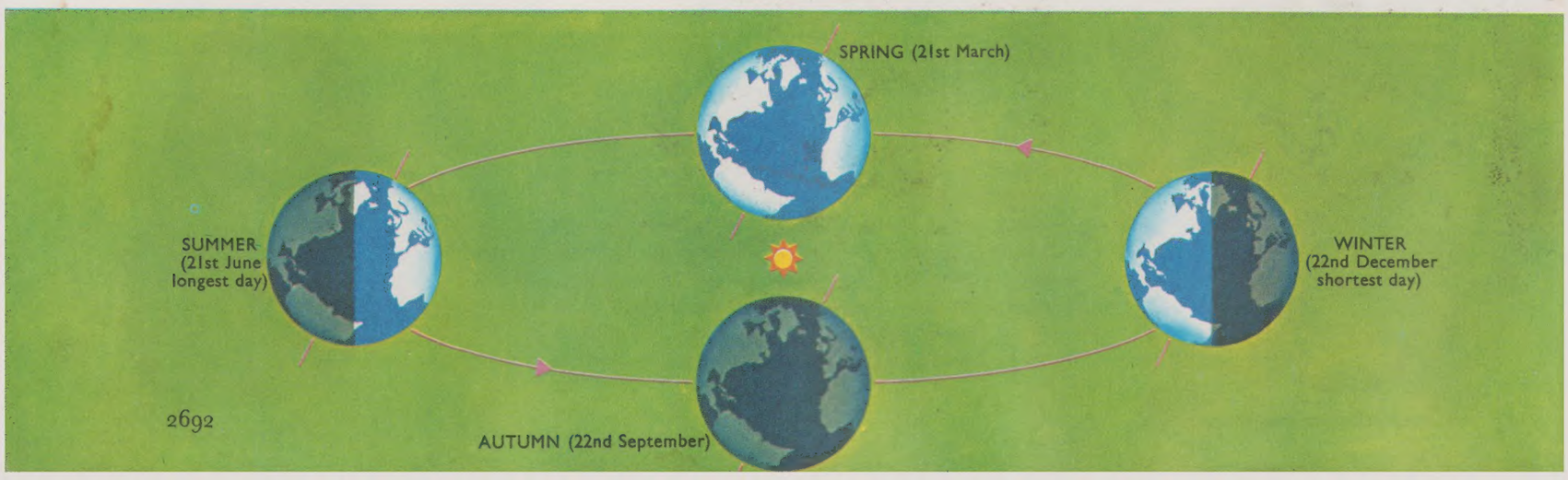
A less direct way in which men have stored the energy of the summer sun is by haymaking. Grass grown rapidly during early summer is cut during June and July. After lying in the field to dry, it is carried away to stacks or barns where it is kept until needed as winter fodder for cattle. The animals which eat the hay give milk for human use, or are themselves eaten. In this way the sun's energy is first stored in the grass and the hay, next transferred to the cattle, and finally it provides man with muscular energy as he goes about his daily tasks.

Why is it warm in summer?

As the earth speeds on its year-long journey around the sun it travels in a vast ellipse, the plane of which is called the *ecliptic*. Simultaneously it rotates on its north-south axis of rotation, which is not perpendicular to the ecliptic, but deviates from the right angle by $23\frac{1}{2}$ degrees. Consequently, during part of the earth's journey around the sun the North Pole is pointed quite markedly away from the sun. Six months later, however, it is tilted the same amount towards the sun. These changes in the tilt of the earth's axis in relation to the sun are responsible for the seasons.

On the right of the diagram below, the earth can be seen in the position which it occupies during winter in the Nor-

The path of the earth round the sun, showing its position at the spring and autumn equinoxes, the summer and winter solstices, the seasons of the Northern Hemisphere

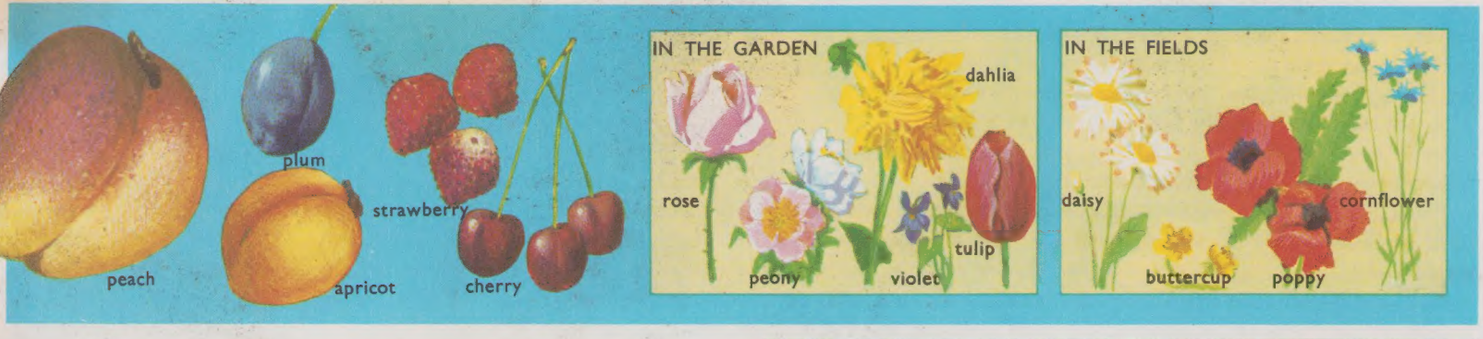


thern Hemisphere. The North Pole points away from the sun, and so the polar regions, always shaded by the rest of the earth, are in continual darkness. The northern temperate region is also tilted away from the sun, and in consequence has short days and long nights. Moreover, the sun's rays, striking very obliquely, provide very little warmth. On the left the earth can be seen in the position which it occupies in the northern summer. The North Pole is now tilted towards the sun, and is in constant daylight. The northern temperate region has long days and short nights, and the rays of the sun strike it more directly, providing the heat of summer days.

berries, raspberries, and currants must be netted to keep away birds, and later picked; and cucumbers and tomatoes grown under glass.

Many birds – particularly migrants like swifts, spotted fly-catchers, and reed warblers – nest in summer, and in the woods and fields animals like squirrels, foxes, and field-mice rear their young. Insects and butterflies appear in their thousands; and bees flock to the flowers, producing 'the live murmur of a summer's day'.

SUMMER FRUITS AND FLOWERS



Plants and wild life in summer

Officially, summer is between 21st June and 22nd September – the summer and autumn equinoxes – but most of us would agree that summer is here when the days start to get longer and warmer, and we change into our summer clothes towards the end of May. In the garden the late tulips are in flower; they are followed by poppies, lupins, irises, peonies, roses – until the flower-beds are a blaze of colour. Although much of the work in the garden which produces these flowers is done at other times of the year, the gardener is not idle in summer – seedlings must be bedded out, beds must be weeded, tall plants staked, dead heads cut off so that plants will continue to bloom, and lawns mown. In the vegetable garden, peas, beans, lettuces, and radishes must all be cultivated, and the winter greens, like sprouts and broccoli, sown. Soft fruits like straw-

SUMMER TEMPERATURES IN DIFFERENT PARTS OF THE WORLD

	average daily maximum	*average daily minimum*
London, July:	73°F	55°F
New York, July:	82°F	66°F
Moscow, July:	76°F	55°F
Death Valley, Calif., July:	116°F	87°F
Cape Town, Jan:	78°F	60°F
Canberra, Jan:	82°F	55°F
Singapore, Jan:	86°F	73°F
South Pole, Dec:	−18·9°F	

Highest ever recorded temperature: Azizia, near Tripoli, Libya: 136°F.

Wild life of all kinds can be seen in the country in summer

HELLENISTIC

Map showing (in red) the Hellenistic kingdoms formed after Alexander's death

'ALEXANDER the Great dead?' said an Athenian. 'Impossible! The whole world would stink!' When Alexander (see page 756) died in 323 B C his empire stretched from Greece to India, from the Caucasus Mountains to Ethiopia. There was no man strong enough to rule over all this; and so for the next 50 years the empire was torn by wars between the 'Successors' – Alexander's generals and their descendants. Each of these wanted to be the one and only successor to Alexander. But when the Gauls, fierce tribes from the north, invaded Greece and Asia Minor, two of the 'Successors', Antigonus Gonatas and Antiochus, had to deal with this foreign threat instead of fighting each other. By 270 the Gauls had been defeated, and Antiochus and Antigonus agreed on peace. Antiochus was confirmed in the Seleucid kingdom (Alexander's eastern conquests, most of Asia as far as the Hindu Kush), called after his father Seleucus, one of Alexander's generals. Antigonus was confirmed in Macedonia, Thessaly, and parts of Greece – the Antigonid kingdom. The Ptolemies continued to rule in Egypt and Libya, as they had since soon after Alexander's death.

Amphora in blue glass, 250 B C. Hellenistic craftsmen were expert in this type of work

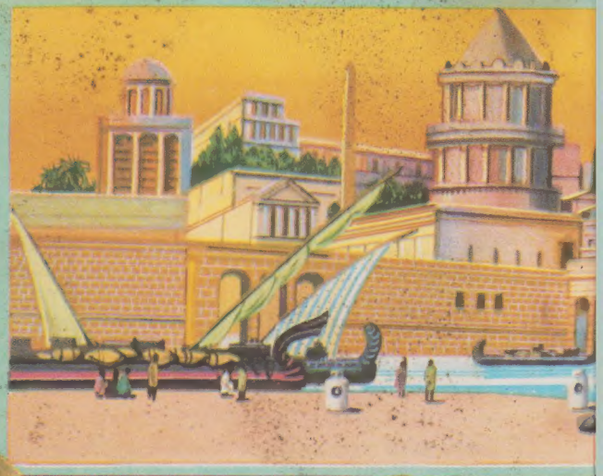
These were the Hellenistic kingdoms, and the Hellenistic period lasted from 323 B C until these kingdoms became parts of the Roman Empire in the 2nd century B C. It is called Hellenistic because Hellenism, or Greek culture, and the Greek language were spread during this time throughout the whole area. Thus, although the kingdoms often fought with each other, they shared the same language, art, and culture.

THE THREE HELLENISTIC KINGDOMS

In the Seleucid kingdom, as Greek was the official language, the natives learned Greek, took Greek names, and adopted Greek habits. The only people whom the Seleucid kings found it impossible to 'Hellenise' were the Jews, but except among them Hellenism triumphed. The Seleucid kings were worshipped as gods by their peoples, and their word was law. After the death of Antiochus IV in 164 B C the dynasty was weakened by internal disputes over the succession and by the attacks of the Parthians, so that by the time Rome annexed Syria and Cilicia (65–63 B C) the Seleucid kingdom had already ceased to exist.

The Antigonid kingdom varied in extent according to the strength of the Achaean league in the Peloponnesus and the Aetolian league in central Greece. After 215 B C the dynasty was gradually weakened by a series of wars against the expanding power of Rome.

The rule of the Ptolemies lasted until the time of Cleopatra. Egypt was like a huge estate run by them for their own profit; the king owned all farm land, and taxation was high. But in spite of the natural resources of Egypt, the kingdom of the Ptolemies, like the Seleucid kingdom in the east, gradually declined.



SCULPTURE OF THE HELLENISTIC PERIOD

Head of Artemis

Detail of the Aphrodite of Melos (Venus de Milo)

Detail of Artemis, goddess of hunting

Detail of a funerary stele (monument)

CIVILISATION

SPLENDOUR AND ISOLATION

This was an age of absolute monarchs, and absolute monarchs tend to have splendid courts in luxurious surroundings. The cities of the Hellenistic period were larger and in many ways more magnificent than classical Athens, but the old city-state was dead. Although there were still cities which claimed to be free and democratic, in fact the kings controlled them. And because cities were now so big, and the old city-state, where people lived together in a small, united society, had vanished, ordinary people now felt more isolated than ever before. Religions and philosophies began to emphasise the importance of the individual; the Stoic philosophy, taught in Athens by Zeno in the 3rd century B C, stated that all men, whether rich or poor, free or enslaved, were brothers under one divine law. Athens remained the centre for Greek philosophy; young men would come from all over the Hellenistic world to study there.

Perhaps the most important single fact about the Hellenistic world was the common language of educated people – the *koine*, a modified form of old Attic Greek. This linked the separate kingdoms, and, later, was the language in which Christ's teaching spread through the Roman world.

Hellenistic artists developed the art of portrait painting

CULTURE

Alexandria was the centre of learning. The Ptolemies were patrons of the arts and of literature, and founded the famous library and the Museum, a research institute. Scholars were encouraged to study the great classical authors, to make editions of their works, and to study grammar and style. Thus literary criticism flourished. But the literature of the Hellenistic age lacked the strength of earlier times; even the poetry was scholarly and difficult. But Alexandrian scientists and mathematicians made new discoveries – for instance, Eratosthenes, who calculated the size of the earth, Euclid, and Archimedes.

A water-carrier. Sculpture became less idealised; the aim was a studied naturalness

Reconstruction of part of Alexandria, the great city of the Ptolemies, in the Hellenistic period (200 B C)

ART

There are many different currents in Hellenistic art; but in general we find greater realism and naturalness than in the sculpture of the Classical period. Hellenistic artists learnt to express character, and developed the art of portrait painting. In the frieze from the altar of Zeus at Pergamum, which shows the battle of gods and giants, the faces and bodies are straining with dramatic effort; it is exciting and realistic, but lacks classical dignity. In art, as in literature, there was a tendency to copy earlier works. By the 1st century B C this tendency had increased, and the inspiration of Hellenistic art had largely vanished.

Reconstruction of part of the great altar of Zeus at Pergamum (about 180 B C) – exciting and realistic, but lacking in classical dignity

CRUSTACEANS

THE crustaceans are allied to the insects, as both groups or Classes are included in the great Phylum Arthropoda or 'jointed-limbed animals'. Insects live mainly on the land while crustaceans, with few exceptions, live in water, the great majority being inhabitants of the sea. It can be said that they play the same part in the sea that insects do on land. The hard-shelled crabs and lobsters crawl on the bottom like beetles, or burrow in the sand and mud like the grubs and wireworms that appear when we dig the garden. The mantis prawn (*Squilla*) lurks and seizes its prey with a pair of claws formed almost exactly like those of a praying mantis, and swimming freely in the water is a host of tiny, delicate crustaceans as countless as the flies that the swallows pursue through the air on a summer day.

Armoured arthropods

As we have said, crustaceans are arthropods, included in the same Phylum as insects, spiders, centipedes, and millipedes. They are more diverse and less easy to define as a group than any of these; almost the only feature that all have in common is the possession of two pairs of antennae, the smaller pair being called the antennules.

Some, but not all of them, have a jointed shell hardened with calcium carbonate or chalk. This shell serves two quite distinct purposes: it acts as a suit of armour to protect the animal from its enemies, and as a skeleton. It is rather difficult to realise that the shell of a lobster is performing the same function as our own bones, but this is so. The legs of the lobster are jointed and work as a system of levers, just as our own limbs do. In the case of humans the muscles which move the limbs are attached to an internal skeleton; in the other case, to the inside of an external skeleton or shell.

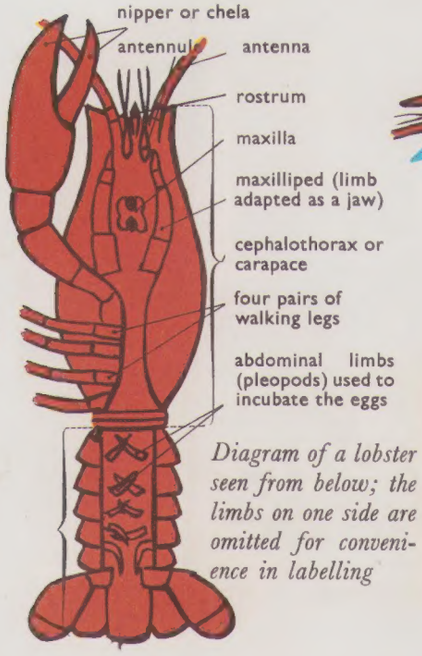
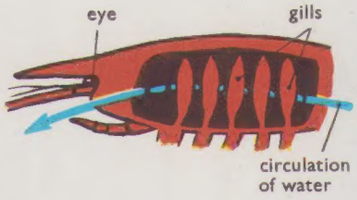


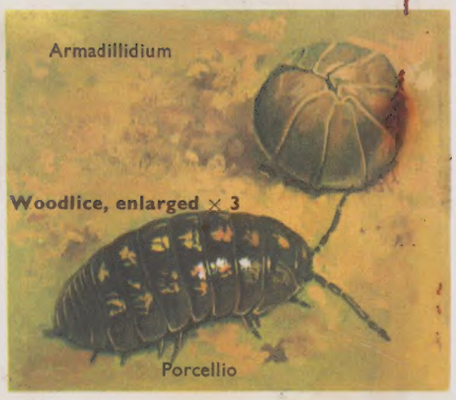
Diagram of a lobster seen from below; the limbs on one side are omitted for convenience in labelling



Gills and water circulation (carapace seen in section)

Some small crustaceans. The crustaceans we are most familiar with, crabs and lobsters, are fair-sized animals, measurable in inches, but there are many more kinds which, though they are not microscopic, are better measured in millimetres. Some of these are so common that everyone must know them by sight.

Woodlice. You can find quantities of these animals whenever you roll over a log or strip dead bark off a tree. They have quite hard shells, and the pill-bug (*Armadillidium*, a kind of woodlice) can roll up in a ball like a hedgehog or armadillo. They were formerly believed to have medicinal properties, and were swallowed like pills. These are the only crustaceans which both live and breed entirely out of the water, but they require damp surroundings.



Gammarus pulex. This is a fresh-water relative of the little sandhoppers that you see leaping about when you pick up a bunch of dead seaweed on the beach. Members of this Order of crustaceans (Amphipoda) are generally flattened from side to side. *Gam-*

Some species of crustaceans are of considerable economic importance as a source of human food. The edible crab is one of these, but we omit it here because it is described on page 338. Most of the other edible crustaceans belong to the Sub-order Macrura – the lobsters, prawns, and shrimps. The 'meat' of these animals is usually provided by the muscles which bend and stretch the jointed hind-body or abdomen, but the claws of crabs and lobsters also contain meat.

Rock lobster or langouste. This is the 'lobster' of the Bay of Biscay and Mediterranean and is found in rocky places at moderate depths. Its antennae have thick, spiny bases, but there are no large claws.

Lobster. The true lobsters live in fairly cold water on both sides of the Atlantic and sometimes grow to a great size, with a weight of between 30 and 40 pounds. Lobsters are dark blue when alive, but the shell turns red when it is boiled.

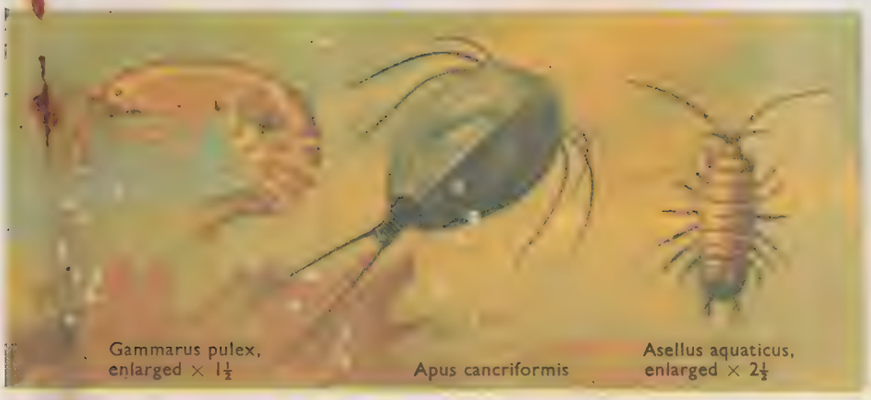
Prawns and shrimps. These cover a great variety of swimming crustaceans, prawns being the larger and shrimps the smaller ones. They are found in salt, fresh, and brackish waters all over the world.

Norway lobster. This is 6 to 8 inches long and like a large prawn, except for its well-developed nippers. It is found in fairly deep water, in northern seas, and is usually caught by dredging.

Mantis prawn. A predatory crustacean, eaten in some Mediterranean countries. Many other species are found in the tropics.

WHERE THEY LIVE

Nearly all crustaceans live in water and the great majority in the sea. The only truly land-living forms are the woodlice, and they require damp surroundings; if exposed to dry air they soon die. Quite a large number live in fresh water, including the crayfish and the well-known 'water flea' or *Daphnia* on which aquarium enthusiasts feed their smallest fish. In the sea crustaceans are found everywhere, from the shore to the abyssal depths, and swimming at all levels in the water.



The plankton that you might find in an enlarged drop of sea-water

marus is very common in fresh-water streams and looks like a tiny shrimp, about half an inch long. It feeds on decaying vegetable matter such as leaves which have fallen into the water.

Apus cancriformis. 'Cancriformis' means 'crab-like', and this little crustacean has a carapace rather like a crab's, but is by no means closely related to these creatures. *Apus* lives in fresh-water pools and feeds on small insect larvae. The **water-louse** (*Asellus aquaticus*) is a fresh-water relative of the woodlice, Order Isopoda.

Plankton. This is the name given to all those animals floating about in the seas and oceans which are carried by currents and have only feeble powers of swimming. Most of the plankton animals are tiny and many of them are crustaceans. Some of these are small species, others are larvae of larger forms, such as crabs, which do not live as plankton when they are adult.

Some small crustaceans – on the left the 'land' crustaceans, and on the right some of those found in fresh water

Prawn (Leander serratus)

Lobster (Homarus vulgaris)

Rock lobster (Palinurus vulgaris)

Mantis prawn (Squilla mantis)

Norway lobster (Nephrops norvegicus)

MULBERRY AND FIG TREES

IN a previous article (page 2676) we gave an account of the Order of plants called Urticales. We described three of the four Families of which the Order consists – the nettle, hemp, and elm Families – and said that the fourth Family would be described in a separate article.

This Family, the Moraceae, is of great botanical interest and of considerable economic importance as well. It consists mainly of trees, and includes the well-known mulberries and figs and also some remarkable tropical trees with enormous fruits; the bread-fruit, illustrated on the opposite page, is an example of these.

Mulberry

Most of the mulberry trees seen in Britain are the black mulberry (*Morus nigra*), which is planted in gardens both as an ornamental tree and for the sake of its fruit. The tree has a short trunk, often dividing into branches only 4 or 5 feet from the ground.

The leaves of the mulberry are large, hairy underneath, and toothed at the edges, rather like those of a wych elm. The flowers are small, male and female being separate but borne on the same tree (the condition known as monoecious). The mulberry itself is really an infructescence – that is, a number of fruits clustered together, each one derived from a separate flower. In appearance it is like a large raspberry, almost black when ripe, and juicy and delicious. Mulberries can be eaten fresh, preserved, or made into jam.

The commercial importance of mulberry trees depends, however, not so much on their fruit as on their leaves, which are the correct food for silkworms (see page 2609). Until the 16th century the black mulberry was used in southern Europe for this purpose. This tree is a native of Persia and the Caucasus, and was introduced into Europe in early historical times both for the sake of its fruit and for its value in silk production.

But the silkworm is an insect of Chinese origin, and, as we might expect, it prefers the leaves on which it is fed in its native land. The white mulberry (*Morus alba*), introduced into Europe from China, superseded the black mulberry as food for silkworms in the 16th century; as a result more and better silk was produced. The white mulberry tree grows rather taller than the black; its leaves are smooth, and the fruit is greenish-white, even when ripe.

There are a few other kinds of mulberry trees in Asia and North America. They can all be propagated by seeds or grafting, or by simply planting a branch.

White mulberry tree (Morus alba)

Fig tree (Ficus carica)

Figs

The figs form a large group of trees with about 700 different species, nearly all of which grow in the hottest regions of the tropics, especially in the equatorial rain forests.

One species, with several cultivated varieties, grows freely in the southern European countries and northern Africa. Its fruit is sold commercially, mostly after it has been dried.

The fruit, like that of the mulberry, is really an infructescence. The part of the shoot on which the terminal inflorescence or 'head' of flowers is situated grows forward right round the entire inflorescence, and encloses it in a hollow, fleshy receptacle, which is pear-shaped, forming what we call the fruit. The receptacle of the wild fig is packed with both male and female flowers. At the apex or 'eye' of the fig there is access from the hollow interior to the open air, a point of some importance, as we shall see shortly.

The leaves are very handsome, large, and lobed.

One cultivated variety, the common fig, is hardy and will even grow in England, if planted so that it is sheltered from the north, preferably by a wall. It produces fruit without pollination and without setting seed.

The Smyrna fig, which grows in warmer climates, bears fruit of much better quality, but the receptacle contains only female flowers, and the fruit will not ripen unless these are pollinated. It was discovered long ago that the way to make Smyrna figs set their fruit is to gather fruit-bearing branches of the wild fig or 'caprifig' and hang them up among those of the Smyrna fig trees. The fruit of the caprifig is useless, but the trees must be grown so that this 'caprification', as it is called, can be carried out. The explanation is that figs can only be pollinated by a certain kind of minute wasp, which lives as a parasite inside the hollow receptacles among the flowers. The wasps find their way out of one fig and into another through the 'eye', carrying the pollen with them. Since Smyrna figs have no male flowers in them, the wild figs are needed to effect pollination, and if a dozen or more of them are hung up it is almost certain that some of them will contain the parasitic wasps. This is a perfect example of symbiosis, since neither the fig nor the wasp is able to complete its life-cycle without its partner.

Tropical figs

We have space to refer to only two of the many tropical figs. One of them, the banyan (*Ficus benghalensis*) is a most extraordinary plant – a single individual can grow and spread to form a small 'wood'. The banyan tree starts its growth as a parasitic creeper on another tree, which it smothers and kills, and at the same time develops a stout trunk of its own. Then aerial roots grow downward from its branches into the earth and thicken to form pillars. These supports enable the branches to spread over a larger and larger area of ground, constantly sending down root pillars as they do so, until the 'tree' covers an area 100 yards across or more.

The india rubber tree (*Ficus elastica*, another fig tree) produces a milky latex which coagulates to form rubber, but practically all natural rubber is now produced from the Para rubber tree, *Hevea brasiliensis* (see page 372).

A banyan tree; the roots growing from the lateral branches form supporting pillars

BREAD-FRUIT

The bread-fruit tree (*Artocarpus incisa*) is native to south-east Asia, but is now cultivated throughout the tropics. It grows to about 50 feet, and the male and female flowers are separate but on the same tree. The female ones grow rather like a mulberry, forming a large, fleshy infructescence, 6 inches in diameter, which is yellowish-green and contains a white, mealy pulp which is eaten baked or roasted.

An allied species, the jack-fruit tree (*Artocarpus integrifolia*), has similar 'fruits', but they are enormous, sometimes as much as 4 feet long. It is also a native of eastern Asia.

Leaves and infructescence of the bread-fruit, a tropical plant native to south-east Asia. The leaves are very large and the infructescence is about 6 inches long

KENNEDY

The making of a president – Kennedy enters Los Angeles during his election campaign

DURING a few days at the end of October 1962 John Fitzgerald Kennedy, president of the United States, was forced to take the fate of the human race into his own hands. He ordered the U S fleet to surround Cuba, where a Soviet missile base had been discovered – only five minutes' flying time from the American coast. He also ordered U S ships to stop and search all Russian ships bound for the island. After a week of almost unbearable tension the Russians agreed to dismantle their missile base. What was, perhaps, potentially the most dangerous crisis in the history of the world was over. When Kennedy took his decision over Cuba he was also taking the risk of unleashing nuclear weapons which could have wiped out the human race. Was this man worthy of the great responsibility his country had given him? Was he one of the really great presidents of the United States? Before these questions could fully be answered John Kennedy was assassinated – shot through the head as he drove in an open car in Dallas, Texas. But the people of his time gave their answer to these questions in their spontaneous reaction to his death. For, in all countries and in all age groups, people felt that they had been robbed of something that could not be replaced. Young people mourned particularly. In a world of ageing statesmen, his vigour, his youthful sincerity, and idealism appealed to them. He spoke for a generation which was not represented among the other powerful statesmen of his time. But above all, both young and old felt that Kennedy still had much to accomplish and to give. No other assassination of any world political leader could have caused such universal horror.

'Let the word go forth from this time and place, to friend and foe alike, that the torch has been passed to a new generation of Americans – born in this century, tempered by war, disciplined by a cold and bitter peace, proud of our ancient heritage – and unwilling to witness or permit the slow undoing of those human rights to which this nation has always been committed, and to which we are committed today.'

FROM KENNEDY'S INAUGURAL SPEECH

The making of a president

John Fitzgerald Kennedy was the youngest man and the first Roman Catholic ever to become president of the United States. He was born in 1917, second son of Joseph P. Kennedy, a wealthy and influential Bostonian of Irish origin, who was United States Ambassador to London between 1937 and 1940.

Even before he entered politics John Kennedy had made his name as a writer and as a war hero. In 1940 he published a book, *While England Slept*, which indicted European statesmen for their unpreparedness before the Second World War. During that war he joined the Navy and was sent to the Pacific. In August 1943 the small craft which he commanded was rammed by a Japanese destroyer. Kennedy succeeded in saving his crew by swimming at great personal risk to a nearby island for help. For his heroism the future president received two of his country's distinguished decorations.

Kennedy entered politics soon after the war, first as a representative for Massachusetts in the Lower House, and then in 1953 as senator for that state. In the same year he married Jacqueline Lee Bouvier.

Narrowly beaten for nomination as Democratic vice-presidential candidate in 1956, Kennedy was accepted as Democratic candidate for the presidency in 1960. In a series of television debates with the Republican candidate, Vice-President Richard Nixon, Kennedy projected himself as a dynamic leader suited to the modern age. The election campaign was exciting. Kennedy won by the narrowest of margins. In November 1960 he took up office as 35th president of the United States.

WHAT KENNEDY SAID: 'Let us never negotiate out of fear. But let us never fear to negotiate.'

'Unconditional war can no longer lead to unconditional victory.'

'While we shall negotiate freely, we shall not negotiate freedom.'

'The basic problems facing the world today are not susceptible to a military solution.'

Commander of the world's most powerful striking force – the President with the joint Chiefs of Staff

THE NEW FRONTIER

Kennedy's administration began with the fervour of a crusade: 'I call upon you all to join us in a journey to the new frontier. The voyage is a long and hazardous one, but we are all partners in a great and historic journey.' Kennedy brought a new type of man into the administration; often young, usually intellectually distinguished, his advisers became known as 'The Kennedy Brains Trust'. And his most important assistants – Dean Rusk, Secretary of State, Robert McNamara, Defence Secretary, and his young brother, Robert Kennedy, Attorney General – were as vigorous and as youthful in their outlook as the President himself. It was certainly a glamorous group – indeed, its atmosphere has been compared to a brilliant court. Behind the glamour was a programme of solid achievement, but also of failure.

FOREIGN AFFAIRS

Latin America

The developing countries in Latin America were very much in the President's mind. He inaugurated the Alliance for Progress designed to help alleviate poverty in these countries and satisfy their basic needs for homes, work, land, health, and schools. Appreciation of this programme has grown, and the United States has, today, considerable support among Latin American countries. However, the island of Cuba was always a thorn in the President's side. In 1961 the American-inspired invasion of the island by Cuban exiles was a failure. But, as we have seen, in the second Cuban crisis, over the Soviet missile base, the President was successful.

Europe

Kennedy wanted the United States to be at the head of a great Western alliance. With Britain his relationship was always most friendly. He was also tremendously popular with the German people for his statement of the United States' determination to defend the freedom of Berlin. However, there was considerable opposition from President de Gaulle of France. France did not want a united Europe under United States leadership. She wanted a united Europe as a third world power, led by France.

Soviet Union

Although Kennedy's administration did not see the end of the Cold War, there was a general lessening of tension between the two great world powers. However, the administration experienced some very dangerous crises: over Laos, Berlin, and Cuba. After the latter, relationships between the two powers improved. In April 1963 it was decided to set up a *hot-line* (direct communications link) between Moscow and Washington. In August a Test Ban Treaty was signed in Moscow. In this treaty it was agreed to ban tests in the atmosphere, outer space, and under water.

HOME AFFAIRS

Kennedy began several major social reforms in his own country: a cut in income tax to increase the amount of the national income; a programme of federal aid for schools to improve the quality of education; free medical care for the aged within the framework of the social security system; and, above all, legislation to improve the position of negroes in the United States. On the last question, Civil Rights, President Kennedy decided to stake the whole future of his administration. He was balked in his lifetime, however, by Congress, which refused to approve many of his measures, or grant him enough money to carry them out.

Space

During the Kennedy administration the first American was put into space; a spacecraft was sent around Venus; the famous communications satellite, Telstar, was launched; and the programme to land a man on the moon greatly advanced.

John and 'Jackie' Kennedy

His place

How will historians judge President Kennedy? Will he be regarded as one of the really great presidents of the United States? Or will he be seen as a great 'might-have-been' or 'successful abroad; a failure at home'? It all depends on whether the main themes of his presidency are developed: his conciliation with the Soviet Union; his plans for Western alliance; his Civil Rights programme; his attempt to assert America's moral leadership of the world. The last theme is one of the most moving of his presidency. He constantly said that the responsibilities of a president of the United States were not merely to his own country but to the whole world. Other politicians had said this before him, but Kennedy, more than any of them, seems to have been passionately involved with his role. In his inaugural address he said: 'To those people in the huts and villages of half the globe struggling to break the bonds of mass misery, we pledge our best efforts to help them help themselves . . . not because the Communists may be doing it, not because we seek their votes, but because it is right.'

WHAT KENNEDY SAID: 'The liberal society is a free society and it is at the same time and for that reason a strong society.'

'The awakening nations of Africa, the restless people of South America, the suffering millions in Asia are all looking for leadership. They need our aid, our strength, our skills, our sympathy, and – above all – our understanding.'

The impressive Kennedy family – Edward (senator), John, and Robert (Attorney General)

M T .

A view of Vesuvius and Monte Somma from the direction of Naples. On the left is the ridge of Monte Somma and in the centre the cone of Vesuvius

IF you spend a holiday in Italy you may well visit Naples and see the famous view across its bay. Behind the blue Mediterranean and the buildings of the waterfront rise the smooth green slopes of a cone-shaped mountain, whose summit seems greyish-purple through the heat haze. The scene looks very peaceful, and it is hard to realise that the mountain is dangerous. But in the past it has destroyed towns and villages and killed thousands of people. It is the most famous volcano in the world – Vesuvius.

A model of Vesuvius and its surroundings; Naples is shown in red

The eruption of A D 79

Probably its most disastrous eruption was that of A D 79 (see page 1361). On 24th August there was a violent explosion which blew vast quantities of material and steam into the air. The town of Pompeii was buried beneath a deluge of dust, ashes, and cinders, while many villages were also overwhelmed. The steam condensed to give torrential rain, which mixed with the volcanic dust and ash to form a pasty mud. This flowed down the mountainside to engulf Herculaneum, filling every nook and cranny until the whole town was submerged. The mud hardened like concrete, covering the town so thoroughly that its existence was undetected until its discovery, by accident, in 1738. The volcanic material has kept these Roman towns in a remarkable state of preservation, and excavations have revealed streets, houses, paintings, and even bodies.

HOW IT WAS FORMED

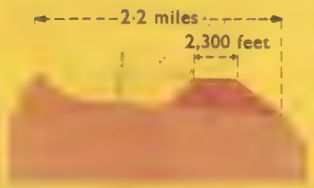
Vesuvius is a volcano within a volcano, for it is located in the *caldera* or volcanic basin of an extinct volcano called Monte Somma. Exactly when the older volcano was formed is not known, but it is thought that at its greatest development it was about 8,000 feet high. Before A D 79 there had been a long period of inactivity, but under the surface the pressure of the molten lava and gases was building up. The resulting explosion, in A D 79, destroyed much of Monte Somma, and its collapse and subsidence led to the development of a broad caldera. Its southern part was occupied by the new peak of Vesuvius, which itself contained a new crater. From time to time cones of lava and ash have formed within Vesuvius's crater, but these have been destroyed in explosive eruptions, which have often modified the shape of the volcano.

① Millions of years ago the volcano Somma emerged from the sea

② In A D 79 Vesuvius formed within Somma's caldera

③ An eruptive cone forms in the crater of Vesuvius

④ In 1944 this cone was destroyed by a further violent eruption



DIMENSIONS

Somma:

Perimeter: base	31 miles
Perimeter: rim	7·1 miles
Diameter	2·2 miles
Maximum height	3,858 feet

Vesuvius:

Perimeter	about 1 mile
Diameter	2,300 feet
Depth of crater	984 feet
Maximum height	about 4,000 feet

Vesuvius is a 'stato-volcano' – one that has been built up of alternate layers of volcanic fragments and lava. This reflects the way it erupts: outbreaks of violence being separated by periods of relative quiet. Major explosions may cause the deposition of millions of tons of material on the mountainside and the emission of lava. In between major eruptions the funnel-shaped crater is filled with layer upon layer of lava, which sometimes overflows, as between 1926 and 1929.

The lava and gases of the volcanic explosions are derived from a 'magma reservoir' of molten rock at a depth of 15,000 to 18,000 feet below sea-level

VESUVIUS

View of the crater of Vesuvius as it is today

The volcano today

As we have seen, Mount Vesuvius, unlike many other volcanoes (see page 2302), does not have an entirely symmetrical shape. This is because it is not one but two volcanoes, the cone of Vesuvius lying within the caldera of the much larger extinct volcano, Monte Somma. At one time this caldera was a shallow basin surrounded by a cliff-like wall, and, during the Slave Revolt of 73–72 B C, the gladiator Spartacus and some of his men defied a Roman army from here. Today the wall survives only in the north, where it forms a rugged, semi-circular bastion rising to a height of 3,858 feet. The southern half was destroyed by the violent explosion of A D 79, when the slopes of Vesuvius and Somma were merged into one, grading smoothly down from the summit of Vesuvius, through the old base of Somma, to the sea.

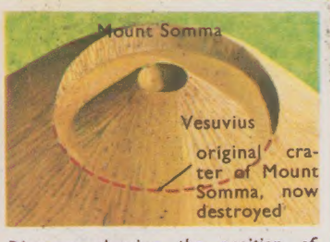


Diagram showing the position of Vesuvius in the caldera of Somma

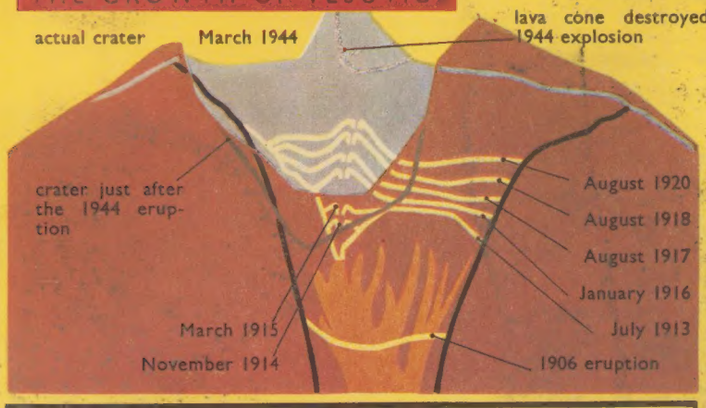
The upper parts of Vesuvius are formed of bare volcanic material – mainly solidified ash, but also lava, pumice, cinders, and rock fragments. On the lower slopes there are numerous vineyards, as there were in Roman times. The owners must think that the risk of disaster is more than repaid by the results they obtain from the fertile volcanic soils. They produce a well-known wine of high quality, called *Lacrima Christi* (which means 'The tears of Christ').

Vesuvius in this century

Although Vesuvius has been active for over 2,000 years, it has been considerably changed during the present century. The eruption of 1906, which lasted for 18 days and was accompanied by earthquake shocks, was one of the biggest in the volcano's history. Lava escaped through fissures in the cone and was also blown into the air; gases rose to a height of 8 miles; and vast quantities of ash were ejected, forming hot avalanches on the mountainside. After the eruption, which caused 197 deaths, the crater was blasted into a funnel 2,000 feet deep.

In the following years this was gradually filled in by successive layers of lava, which piled up to form an eruptive cone. In 1929 the crater became a lake of glowing molten lava, which spilled over the rim to overwhelm several small villages; pieces of slag were hurled 4 miles. The violent eruption of 1944 destroyed the inner eruptive cone, leaving a deep crater again (see below, left).

THE GROWTH OF VESUVIUS



Section showing changes in the crater and eruptive cone since 1906

VESUVIUS BEFORE THE 20TH CENTURY

The first reliable account of an eruption of Vesuvius is contained in a letter written to Tacitus by the Younger Pliny, in which he describes the disaster of A D 79. Before this date the volcano had been dormant for so long that the Romans had thought it extinct. Since that first violent explosion, which established Vesuvius in the basic form we know today, there have been a number of eruptions at irregular intervals and of varying intensity. Some have had little effect, but others have also caused great damage and loss of life.

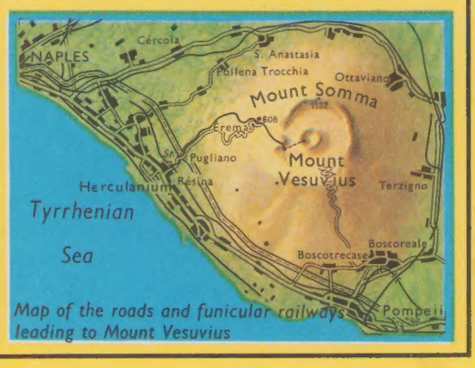
The eruption of 16th December 1631 was especially violent. Vast clouds of dust and rock fragments were hurled into the air, and some of the finer dust reached Constantinople, 800 miles away. Muddy streams of condensed steam, ash, and dust spread far and wide over the adjacent plains, while lava flows occurred in the south and west. 18,000 people were said to have perished in this great disaster.

Other eruptions – for instance, those of 1767, 1822, and 1872 – were also extremely violent and altered the shape of the volcano.

A TOURIST ATTRACTION

As the most famous volcano in the world, Vesuvius is naturally a centre for the tourist industry. Because it is situated only 7 miles from the great city of Naples and near to the Naples–Pompeii *autostrada* (motorway), it is easy to reach. Two roads wind up its steep sides, and there is a funicular railway which runs from nearby Pugliano station to the rim of Monte Somma.

On the north-east flank there is an observatory, founded in 1844, for scientific study of the volcano.



Map of the roads and funicular railways leading to Mount Vesuvius

C O A L - G A S

TURN a tap, apply a light, and *prupp* . . . a hot blue flame appears as if by magic. The instant heat of gas is always ready to warm water, to cook a meal, to warm a room, to operate a central-heating system, and, strange though it may seem, to cool a refrigerator (see page 2225). Furthermore, gas is used in industry to heat factories and offices, to fire furnaces, and to provide energy for chemical processes. The quantity sold in Britain in 1962 was approximately 50,000 million cubic feet, and 22 million tons of coal were used in its manufacture.

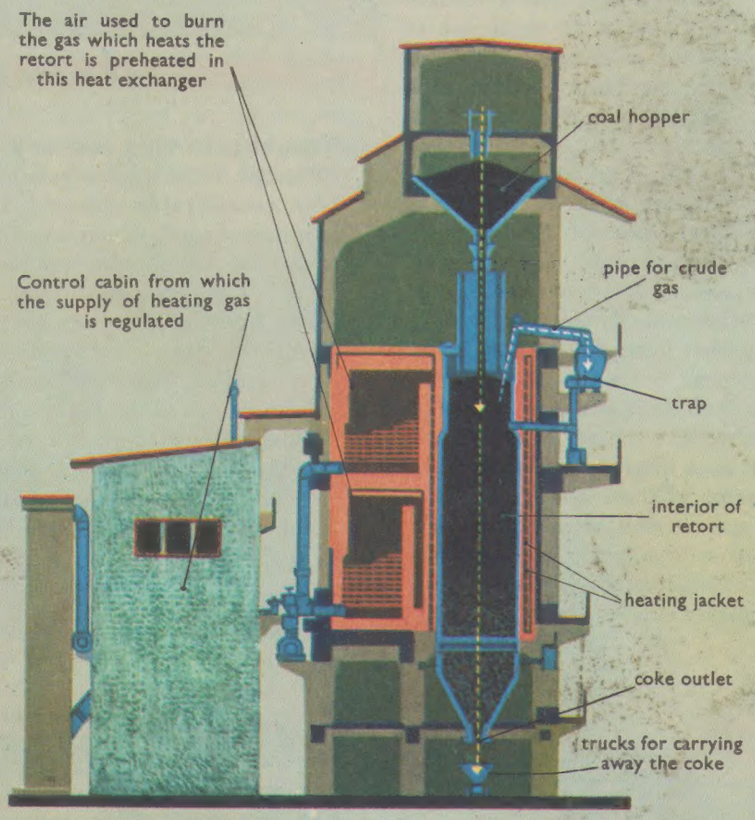
GAS MANUFACTURE

Gas is made by the distillation of coal. This process, known as *carbonisation*, is carried out in large retorts which are filled with coal of suitable quality and then heated, either by coal or by gas, to 1,000°C. As the temperature rises, the coal within the retort softens and gives off a thick brown smoke which is led away in pipes. From this smoke, which is really *crude coal-gas*, the saleable product is prepared. The residue left in the retort when carbonisation is complete is *coke*. It is removed from the retort, graded into fragments of various sizes, and sold as smokeless fuel.

At one time the retorts used in gas-making were all of the horizontal pattern. Today, however, there are many vertical retorts in which the coal is fed in at the top and the coke removed at the bottom. In some vertical retorts carbonisation is continuous, the contents of the retort falling downwards as they become carbonised and as more coal is steadily fed in at the top.

The crude gas from the retorts contains not only coal-gas but ammonia, tar, and hydrogen sulphide. The ammonia and tar condense as the gas cools and are led off into tanks. The hydrogen sulphide is removed in a *purifier*. The removal of this gas is particularly important, for not only does it have the foul smell of bad eggs, but it is also very poisonous.

After purification the gas is metered and pumped into gas holders. Here it is stored until the demand for gas requires it to be fed into the supply mains.


The air used to burn the gas which heats the retort is preheated in this heat exchanger
coal hopper
Control cabin from which the supply of heating gas is regulated
pipe for crude gas
trap
interior of retort
heating jacket
coke outlet
trucks for carrying away the coke

Sectional view of a vertical retort designed for continuous working

BY-PRODUCTS OF GAS MANUFACTURE

The most obvious by-product of gas manufacture is the coke left in the retort at the end of the carbonisation process. In the days of cheap and plentiful coal the disposal of this material presented a considerable problem to many gas producers. Today, however, the need for coke is so great that in several areas the demand exceeds supply. It is used for the efficient household boilers now available and for industrial boilers, while the gas producers themselves use considerable amounts to make two types of gas, *producer-gas* and *water-gas*, which are sometimes mixed with coal-gas.

The substances which condense out of crude coal-gas as it cools after it has left the retort separate into two layers. The upper layer is called the *ammoniacal liquor*, as it contains large amounts of ammonia. This is converted into ammonium sulphate, and is used as a fertiliser. The lower layer consists of tar. Each year Britain's gasworks produce 1¾ million tons of this material. It is extensively used to provide roads and airport runways with strong and dust-free surfaces. The layer of tar is, in addition, the source of 25 million gallons of benzole motor fuel, of creosote, and of materials as different as nylon, plastics, dyestuffs, cosmetics, and drugs.

NEW DEVELOPMENTS

Gas engineers are always seeking new sources of gas and new ways of making their product. Among the new sources the most exciting is the vast deposits of the natural gas, *methane*, in the Sahara. A tanker has been built to carry liquid methane to Britain, and in a few years' time it may provide as much as one-tenth of her supply. Small amounts of methane (known to miners as *fire-damp*) have been extracted from British coal mines and used with great success in places.

Other new sources of gas include oil, certain products of oil refineries, and grades of coal once thought unsuitable for gas-making.

One interesting new development is the process called *total gasification*. In this, coal is carbonised with crude oil; *all* the coal is carbonised, so that the yield of gas is much increased while the residue of coke is cut out.

EARLY GAS LIGHTING

London: experimentally in	
Lyceum Theatre	1803
Mall lit	1807
Pall Mall lit	1809
USA: private lighting of house and street, Newport R.I.	1812
First interior commercial use, a Philadelphia theatre	1816

COMPOSITION OF COAL-GAS

The composition of coal-gas varies with the quality of the coal used, the type of retort, and the temperature of carbonisation. Chiefly, however, it consists of the following three gases in roughly these proportions:

Hydrogen:	50%
Methane:	25%
Carbon monoxide:	15%

The remaining 10% consists of carbon dioxide, hydrocarbons, nitrogen, oxygen, and so on.

The composition of the gas which is supplied for public use, however, may differ considerably from this if large amounts of gas from sources other than coal are added to it.

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GEM CUTTING

Jasper cameo, richly set in enamelled gold

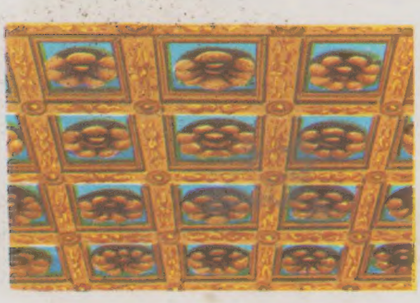
Most transparent gems today are faceted (cut to bring out the maximum light and colour); but opaque stones like opals are usually simply polished until they are smooth (known as *en cabochon*). In stones with layers of different colours, like the onyx, the upper layer can be delicately carved, exposing part of the layer beneath which is polished. This is *cameo* work.

ENAMEL WORK

17th-century fish of enamelled silver

Enamel is a form of decoration in which powdered glass is fused to certain metallic surfaces. In *champlevé*, the metal is cut away in troughs, which are filled with different-coloured enamels; in *cloisonné*, metal strips are fixed to the surface, forming compartments for the enamels; in *painted*, the enamel is applied all over and then added to in coloured patterns.

CARVING

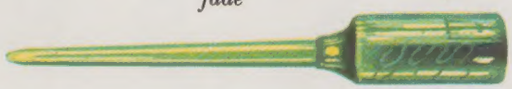


Coffered Renaissance ceiling

Wood-carving can have many artistic uses. Figures can be sculpted out of wood in the same way as stone; and it can be carved in relief (see **Sculpture**) for decoration. In the Middle Ages and Renaissance the greatest wood-carvings were done for church buildings – rood screens, doors, and choir stalls. In houses, carved wood was used for coffered ceilings (below left), panelling, chests, and bedsteads; while small objects like candlesticks, chessmen, and pipecases were also carved in wood.

Certain semi-precious materials like **ivory, soapstone, coral,** and **jade** can also be carved. This is traditionally an eastern art, and the delicate figurines and ornamental objects, like paper knives, bowls, and jewellery, are often very valuable.

Mexican figurine and paper knife of carved jade



GLASS WORK

Two pieces of delicately enamelled 16th-century Murano glass

The art of making **glass,** which includes blowing, cutting, engraving, colouring, and painting it, covers a vast field – from the production of vases to that of church windows. From the 12th century onwards Murano (Venice) was the European centre; in the 17th century Bohemian engravers came to the fore; today, the simple, heavy Scandinavian glass is popular.

MARQUETRY

Marquetry, inlay, and **intarsio** are methods of setting wood with designs of other woods, ivory, mother-of-pearl, and so on. In marquetry the inset material is only a thin *veneer*; inlay and intarsio are deeper – intarsio referring only to inset wood. The processes were used especially in cabinets, long-case clocks, and musical instruments.

Inlaid 18th-century cupboard

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POTTERY AND PORCELAIN

Pottery and **porcelain** are made from clay, sometimes mixed with other materials, which is baked or fired to harden it. Porcelain is the finest and most delicate kind of pottery, translucent with a transparent glaze, which is made from kaolin or china clay.

Beautifully glazed and decorated pottery has been made for many centuries. Perhaps the loveliest is the Italian Renaissance tin-glazed pottery known as *maiolica*.

This type of pottery was made in France (16th century on), where it was known as *faience*; in Delft in the Netherlands (17th century on); and in England, particularly at Bristol (17th and 18th centuries).

Richly decorated plate of Italian maiolica pottery

Tureen and dish of 18th-century Sèvres porcelain

The art of making porcelain originated in China (hence our name china), and the work of the great oriental makers is probably the most valuable in the world. The making of true porcelain (as opposed to an imitation 'soft-paste' porcelain) in Europe began in the early 18th century, with the Meissen (Dresden) potteries leading the way (1725). In the same century grew up the great potteries of France (Sèvres and Limoges) and England (Chelsea, Derby, Worcester, Spode, and Wedgwood), many of which still exist today.

Pottery – apothecary's jar

Illuminated 14th-century manuscript, showing St George and the dragon

MINIATURE PAINTING

'Miniature' comes from the Latin *minium*, vermilion, the most popular colour used in mediaeval manuscript illuminations. These were the first miniatures, but this art of minutely detailed painting later came to be used almost exclusively for portraits – on skin, bone, metal, and, from the 18th century onwards, on ivory. Holbein (1497–1543) was one of the first and greatest portrait miniaturists.

MOSAIC WORK

Mosaic is the art of decorating smooth surfaces with closely set pieces of minerals, glass, tile, or, more often, stone. Many of the beautiful Greek and Roman mosaic pavements still survive. The Greeks were the first to use regular cube-shaped pieces of mosaic, which are called *tesserae*. In the Byzantine period mosaic became a *major* art; fabulous wall mosaics can still be seen in Rome, Ravenna, Salonica, Athens, Sicily, and Venice.

Mosaics are sometimes used to decorate the walls and floors of modern buildings.

Detail of a mosaic in the Basilica of St Maria Maggiore, Rome